

Technical Report 5-20549 & 5-20550
Contract No. DAAH01-98-D-R001
Delivery Order No. 46

**Microelectronic Spare and Repair Part
Status Analysis
of the PATRIOT Weapon System.**

(5-20549 & 5-20550)

Final Technical Report for Period
9 April 1999 through 31 August 1999

October 1999

Prepared by:

Gary A. Maddux

Systems Management & Production Lab
The University of Alabama in Huntsville
Huntsville, Alabama 35899

Prepared for:

U.S. Army Aviation & Missile Command
Redstone Arsenal, AL 35898
Attn.: Mr. Steve Pearce

20000309 095

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Service, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE October 99	3. REPORT TYPE AND DATES COVERED Final Report: 9 APR 99 thru 31 AUG 99		
4. TITLE AND SUBTITLE Microelectronic Spare and Repair Part Status Analysis of the Patriot Weapon System.		5. FUNDING NUMBERS		
6. AUTHOR(S) Gary A. Maddux				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Univ. of Alabama in Huntsville Huntsville, AL 35899		8. PERFORMING ORGANIZATION REPORT NUMBER 5-20549 & 5-20550		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) AMSAM-RD-SE-MT (S. PEARCE) U.S. Army Aviation & Missile Command Redstone Arsenal, AL 35898		10. SPONSORING / MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution is unlimited.		12b. DISTRIBUTION CODE A		
13. ABSTRACT (Maximum 200 words) The Manufacturing Science and Technology Division (MS&TD), AMCOM has the mission and function of providing microelectronic technology assessments, and producibility and supportability analyses for the PATRIOT weapon system. MS&TD evaluates the impacts of nonavailability of microelectronic parts on the life cycle supportability of the PATRIOT weapon system and evaluates the producibility of the PATRIOT weapon system. MS&TD required engineering support in performing microelectronic technology and availability assessments for several hundred items and in assessing the impact of nonavailability on the PATRIOT weapon system. MS&TD also required engineering support in performing producibility analyses of the PATRIOT weapon system. In order to facilitate the assessment of this system, the UAH Systems Management and Production Laboratory was tasked to conduct an in-depth analysis as to the life cycle health of the PATRIOT weapon system's component parts.				
14. SUBJECT TERMS obsolescence; PATRIOT			15. NUMBER OF PAGES 3	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	

PLEASE CHECK THE APPROPRIATE BLOCK BELOW

DAO# _____

☐ _____ copies are being forwarded. Indicate whether Statement A, B, C, D, E, F, or X applies.

☒ DISTRIBUTION STATEMENT A:
APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED

☐ DISTRIBUTION STATEMENT B:
DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES
ONLY; (indicate Reason and Date). OTHER REQUESTS FOR THIS
DOCUMENT SHALL BE REFERRED TO (Indicate Controlling DoD Office).

☐ DISTRIBUTION STATEMENT C:
DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES AND
THEIR CONTRACTS (Indicate Reason and Date). OTHER REQUESTS
FOR THIS DOCUMENT SHALL BE REFERRED TO (Indicate Controlling DoD Office).

☐ DISTRIBUTION STATEMENT D:
DISTRIBUTION AUTHORIZED TO DoD AND U.S. DoD CONTRACTORS
ONLY; (Indicate Reason and Date). OTHER REQUESTS SHALL BE REFERRED TO
(Indicate Controlling DoD Office).

☐ DISTRIBUTION STATEMENT E:
DISTRIBUTION AUTHORIZED TO DoD COMPONENTS ONLY; (Indicate
Reason and Date). OTHER REQUESTS SHALL BE REFERRED TO (Indicate Controlling DoD Office).

☐ DISTRIBUTION STATEMENT F:
FUTHER DISSEMINATION ONLY AS DIRECTED BY (Indicate Controlling DoD Office
and Date) or HIGHER DoD AUTHORITY.

☐ DISTRIBUTION STATEMENT X:
DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES
AND PRIVATE INDIVIDUALS OR ENTERPRISES ELIGIBLE TO OBTAIN EXPORT-CONTROLLED
TECHNICAL DATA IN ACCORDANCE WITH DoD DIRECTIVE 5230.25. WITHHOLDING OF
UNCLASSIFIED TECHNICAL DATA FROM PUBLIC DISCLOSURE, 6 Nov 1984 (indicate date of
determination). CONTROLLING DoD OFFICE IS (Indicate Controlling DoD Office).

☐ This document was previously forwarded to DTIC on _____ (date) and the
AD number is _____.

☐ In accordance with provisions of DoD instructions. The document requested is not supplied because:

☐ It will be published at a later date. (Enter approximate date, if known).

☐ Other. (Give Reason)

DoD Directive 5230.24, "Distribution Statements on Technical Documents," 18 Mar 87, contains seven distribution statements, as described briefly above. Technical Documents must be assigned distribution statements.

GARY A. MADDUX

Print or Type Name

Gary A Maddux 22 Oct 99
Authorized Signature/Date

256 890 6343 x223

Telephone Number

PREFACE

This technical report was prepared by the staff of the Research Institute, The University of Alabama in Huntsville. The purpose of this report is to provide documentation of the work performed and results obtained under Delivery Order 46 of AMCOM Contract No. DAAH01-98-D-R001. Mr. Gary Maddux was the principal investigator. Mr. Dustin Ross served as lead engineer. Mr. Steve Pearce, Manufacturing Science and Technology Division, Systems Engineering and Production Directorate, Research, Development, and Engineering Center, U.S. Army Aviation & Missile Command, provided technical coordination.

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other official documentation.

Except as provided by the Contract Data Requirements List DD Form 1423, hereof, the distribution of any contract report in any state of development or completion is prohibited without the approval of the Contracting Officer.

Prepared for: Commander
U.S. Army Aviation & Missile Command
Redstone Arsenal, AL 35898

I have reviewed this report, dated October 1999 and the report contains no classified information.

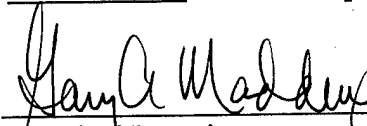

Principal Investigator

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
2.0	OBJECTIVES	1
3.0	STATEMENT OF WORK	1
4.0	ASSESSMENT OF PATRIOT WEAPON SYSTEM	3
5.0	CONCLUSIONS AND RECOMMENDATIONS	3

1.0 Introduction

The Manufacturing Science and Technology Division (MS&TD), SEPD, RDEC, AMCOM has the mission and function of providing microelectronic technology assessments, and producibility and supportability analyses for the PATRIOT weapon system. MS&TD evaluates the impacts of nonavailability of microelectronic parts on the life cycle supportability of the PATRIOT weapon system and evaluates the producibility of the PATRIOT weapon system. MS&TD required engineering support in performing microelectronic technology and availability assessments for several hundred items and in assessing the impact of nonavailability on the PATRIOT weapon system. MS&TD also required engineering support in performing producibility analyses of the PATRIOT weapon system.

In order to facilitate the assessment of this system, the Systems Management and Production Laboratory at The University of Alabama in Huntsville Research Institute was tasked to conduct an in-depth analysis as to the life cycle health of the PATRIOT weapon system's component parts.

2.0 Objective

The purpose of the work to be performed under this task order was to provide management and engineering support to analyze the availability of microelectronics used in the PATRIOT system and to investigate and develop solutions for problem parts. General microelectronic engineering support was required to support special studies and the implementation of commercial products, processes, and specifications for AMCOM systems. Determination of the producibility of the PATRIOT system and subsystem was required.

3.0 Statement of Work

The statement of work, as outlined in delivery order 46, was as follows:

- 3.1 UAH shall analyze the availability of microelectronic parts used in the PATRIOT weapon system. The analyses shall be for PATRIOT microelectronics specifically identified by the IOD. UAH shall determine and categorize the availability status of the individual components. UAH shall assess the impact of the non-availability of the microelectronics on system supportability. UAH shall evaluate and recommend problem resolution approaches. UAH shall identify opportunities for insertion of new electronic technologies to resolve microelectronic availability and obsolescence problems. The analyses shall be performed using government furnished databases and automated tools such as the Enhanced Microcircuit Obsolescence Analysis Tool (EMOAT) Local area network and other information services. Other available sources of information shall be used as required. Analyses results shall be recorded in database format which shall be compatible

with current government databases and delivered in digital and written report format to the government. Results also shall be presented to pertinent personnel through briefings and written reports.

- 3.1.1 UAH shall define microelectronic component obsolescence assessment methods and analyze current government obsolescence assessment methods. Additional approaches and information sources shall be analyzed and developed. Analysis methods, data sources, criteria and reporting formats shall be documented within all written reports. UAH shall establish routine monitoring of Government Industry Data Exchange Program (GIDEP) and industry announcements for obsolescence notifications and impacts to the PATRIOT system.
- 3.1.2 UAH shall research and analyze the PATRIOT weapon system microelectronic component availability data. Commercial and government databases shall be searched for data on microelectronic obsolescence and availability. Alternate sources, part numbers and qualified substitutes for obsolete or unavailable parts shall be identified. Compliance with military standards shall be verified. Specific alternate and substitute parts for those determined obsolete or determined to pose obsolescence potential shall be recommended.
- 3.1.3 UAH shall assess PATRIOT weapon system readiness, producibility, and supportability impacts resulting from microelectronic obsolescence. Specific component availability and obsolescence problems affecting the PATRIOT system shall be identified. Quantitative statistics to demonstrate the impacts at the system, line replaceable unit (LRU), circuit board and component levels shall be derived. Potential approaches to resolve availability and obsolescence problems and reduction of their impacts on system supportability shall be proposed.
- 3.1.4 UAH shall identify opportunities for insertion of microelectronic technologies into the PATRIOT weapon system. LRUs, or boards, which are candidates for redesign based on their use of obsolete microelectronics, shall be identified.
- 3.1.5 UAH shall support acquisition streamlining by identifying commercial microelectronic components as replacements for military qualified components. UAH shall verify form, fit, and function compatibility. UAH shall verify commercial component availability. Cost comparisons shall be completed. UAH shall investigate commercialization of electronic processes and specifications.
- 3.1.6 UAH shall investigate the use of the technology insertion program to resolve deficient technical data packages (TDP), eliminate sole source TDPs, and delete Reliability, Availability, and Maintainability (RAM) problems. Benefits in terms of improved performance, producibility, readiness and life cycle costs shall be demonstrated.

- 3.2 UAH shall analyze the producibility of the PATRIOT weapon system and subsystems. The analyses shall be performed on parts specifically identified by the government. UAH shall analyze TDP data (listings, engineering documentation and changes thereto) to advise the government if the present baseline and/or detail drawings are adequate for competitive procurement and/or manufacture. UAH shall, during TDP analysis, document any cost reduction opportunities in the TDP, using value engineering methodology as a generally accepted practice of cost analysis. UAH shall provide a written report for each TDP analyzed. The report shall detail any deficiencies and provide recommended solutions. UAH shall provide recommended TDP updates where applicable.
- 3.3 UAH shall perform an engineering analysis on producibility problems identified during the procurement cycle of PATRIOT secondary items. The analysis shall require review of drawings, specifications, and related materials pertaining to the identified problem. UAH shall determine and recommend solutions to the producibility problems and provide rationale to support recommendations. Results to the analysis shall be prepared and furnished in a written report.

4.0 Assessment of the PATRIOT Weapon System

Under this task members of the UAH Systems Management and Production Lab performed a detailed engineering analysis on the component parts of the PATRIOT weapon system. Specifically, microelectronic components were analyzed according to their availability and expected life cycle. To ascertain this information, UAH worked with the electronics industry, the PATRIOT Project Office, and other government agencies.

The results of this task were delivered to MS&TD under separate cover.

5.0 Conclusion and Recommendations

During the time frame allocated by the delivery order, members of the UAH Systems Management and Production Lab, with the cooperation of representatives from AMCOM Systems Engineering and Production Directorate and the PATRIOT Project Office investigated the life cycle supportability of the microelectronics of the PATRIOT weapon system. Because of the rapidly changing microelectronics industry, it is imperative that this assessment be refreshed on a periodic basis. Only through the diligent monitoring of a complex system can its sustainability issues be properly addressed. It is recommended that the PATRIOT Project Office adopt a proactive obsolescence management philosophy so that the total cost of ownership is reduced over the system's life cycle.